

BACKGROUND OF THE INVENTION

The present invention consists of a system and method for the tracking, storing and maintaining of objects and the accordant data as to the location of objects or personnel having RFID tags attached thereto in a defined zone or geographic area such as, by way of example, buildings, factories, tractor-trailers, aircraft, railroad cars or other areas where the zones have plurality of points of access or within a defined area. It is a further objective of the invention to provide an improved object or personnel tracking and control system which makes use of a portal RF antenna with infrared optical sensors that can scan the object or personnel RFID tag and, with optical sensors, can detect and determine the direction in which objects or personnel are moving. With the use of IR heat sensing and motion sensing sensors, said method and invention can further can determine the presence or absence of an object without an RFID tag, the direction of such object as well as whether said moving object is a person or not.

A number of different methods have been used in the past to track the location of large numbers of objects (pallets of cargo, packages etc.) or personnel located within buildings, trailers, containers, buses, and aircrafts. These methods have been used for purposes of tracking cargo, employee attendance, school attendance, or logging in passenger manifest along with carry on luggage. The oldest of this method is by keeping an inventory register of each warehouse or vehicle content and it's delivery records in a paper journal, attendance punch cards, or more recently, with the use of computers or a hand held computerized device and database. The accuracy of inventory or personnel registry depends on each individual operator properly inputting information relating to packages or personnel. Such a system is limited to assessing the number of objects or pallets and cannot accurately identify the location of each and every pallet, package or personnel and entails significant costs from a human resources standpoint.

As one might expect, a variety of different approaches have been taken to attempt to solve the problem of monitoring large numbers of vehicles, cargo pallets, packages and/or personnel at a specific location (such as a warehouse or office building) or in a vehicle/trailer. From a security perspective, certain applications for purposes of monitoring cargo pallets, packages, luggage, personnel and/or passengers relating to vehicle content, warehouse site, retail stores, schools, at port of entry, and airports also require tremendous recourses including security guards, video monitors, magnetic tag detectors, metal detectors, access controls, bar-code readers as well as mechanical or optical counters. While such approaches may reduce the incident of theft, hijacking, personnel attendance, they are not useful in the addressing the primary problem contemplated by the present invention, namely how to keep track of the location of a plurality of cargo pallets, packages and/or personnel carried in various modes of transportation and/or within a defined geographic area or zone such as warehouses or buildings.

One such system is illustrated in **US Patent No. 4,009,389 to Lindholm**. Apparatus for the automatic counting of passengers. Provides an apparatus for detecting the number of passengers entering and/or leaving a collective passenger vehicle, by use of projecting a pair of light-beams of invisible light across passenger door way, detecting with the light beam in response to first and second light.

Another such example is **U.S. Patent No. 4,528,679 To Shahbaz et al**. Automatic counting system for Passages. For counting the passengers moving into and out of a common carrier vehicle. By use of three ultrasonic detectors to determine the presence and absence of passengers, the sequence of detection of passengers at the three different ranging establish a count of number of passengers entering or leaving.

US Patent No. 5,485,347 to Miura. Riding situation Guiding Management System. Used with plural of cars constituting a train, an up/down counter for counting passengers getting on and off each car with passenger sensor/counter provided at doorways and pass ways of cars. The infrared temperature sensors element sensing temperature and pair of photo sensors are serving as direction sensor determining whether a passing passenger is getting on or off a car.

US Patent No. 5,068,537 to Ishikawa et al. Describes a Passenger number sensor System wherein a plurality of infrared ray sensors are disposed on a straight line to detect temperature change, a plurality of optical lenses are provided one for each of the plurality of infrared sensors, and a counter is provided to select one of the addition value in a predetermined range according to sense pattern on the temperature change of infrared ray sensors and add the selected addition value to accumulate count value.

US Patent 5,866,887 to Hashimoto et al, Describes an apparatus for detecting the number of passers. A plurality of row are provided on a ceiling of sensors and each have a plurality of distance variation measuring sensors. The distance variation measuring sensors include a light emitter and a light receiver in an orthogonal direction to the direction in which human pass. The number of passers is detected on the basis of the number of the distance variation measuring. The traveling direction of human bodies is detected on the basis of the change in distance.

US Patent 6,255,946 to Kim Discloses a System for detecting the presence and direction of an object passing through a gate, using a first and second infrared beams to emit to the reflector, receives a mixed beam in which the first and second beams reflected by the reflector are superimposed, and determines the presence and direction of the object passing through the gate on the mixed beam

U.S. Patent No. 5,661,457 to Ghaffari et al. Teaches directional antenna configuration for asset tracking system, for use in an article tracking, includes a pair of shorted loops antenna, one on each side of portal. The antenna configuration also includes a respective second pair of passage antennas are arranged in parallel to the path of travel through the doorway. The antenna configuration permits detection of direction of movement of marked object through a portal.

US Patent No. 5,708,423 to Ghaffari et al. Zone-Based asset tracking and Control System, incorporated with a data processing system maintains records of plurality of objects. Each object having a marker. At least four Sensors devices are installed at respective doorway two on each side. Each marked object is moved through the doorway. The sensor devise detects from the identification signal a direction in which object is being moved. The data processing system receives the detection signal and maintain a data record indicating object present location in the building.

US Patent 4,009,389 to Lindhom, 5,485,347 to Miura, 5,068,537 to Ishikawa et al, 5,866,887 to Hashimoto et al, 6,255,946 to Kim, teachings uses optical sensors for detection of directional movement, and counting of human at an entry/exit point.

The teachings in the prior art are not capable of authenticating objects, passers or passengers passing through a particular entry/exit point. **US patent 4,528,679 to Shahbaz** discloses a similar art using ultrasonic sensors instead of optical sensor. And **US Patent 5,661,457 and 5,708,423 to Ghaffari** teaches asset tracking by use of multiple portal antennas for reading RFID markers and indicating directional movement of objects or personnel carrying markers. The art found in Ghaffari is useful but not practical in use. In order to fill an average trailer or building entry/exit way with RF field, an antenna loop is being used to cover an entry/exit opening area usually about 8feet (4m). Since RFID read antennas radiates a 360 degree RF field, as per Ghaffari teaching, in order to detect marked objects or personnel directional movements, minimum of 2 antennas use is required on one side towards an entry way (one after the other, along the entry way), the 2 antennas have to be away from each other by at list 8 feet apart. In order for the RFID antenna reader CPU to be able to detect directional movement of the object or person carrying marker.

First the reader must determine the actual physical location of a moving object or personnel carrying a marker, this is accomplished by determining which one of the to 2 antennas interrogated first and which one interrogated second, in order to register a marked object or personnel direction movement detection. which is pending on physical position of the object or personnel carrying RFID tag at the time of antenna reading. If antennas are less then 8 feet apart the reader CPU cannot differentiate the tag position because both antennas can read a particular RFID tag at the same time. Even though as per Ghaffari teaching only one antenna reading has being initiated by the reader CPU at a given time, to avoid RF collision. Ghaffari teaching requires a large unusable area in an entry/exit way. One cannot store objects or seat tagged passengers in an entry/exit way (Half of a container, trailer, passenger car) where such antennas are installed. In order to avoid falls marker reading, one has to consider unusable valuable space to be wasted for antennas use. Unusable space is a crucial matter, especially in a cargo trailer, passenger car or within small building with partitions.

It should be noted as per Ghaffari teaching use of 4 antennas in a portal entry/exit as illustrated, for moving marker directional detection. The antennas are operating one at a time interval, one after the other in order to avoid RF collision, thus delaying marker reading speed. Therefore, if an object or personnel carrying the marker passes portal antenna zone at fast speed will not be detected, or even if detected the CPU will not be able to differentiate object or personnel carrying marker movement direction. Finally, since Ghaffari teachings rely only on an RFID antenna interrogation system to detect movement of marked object, one can pass a marked object behind a antenna panel, a wall patrician, or pass an object or personnel tag on the outer side of a cargo trailer, or a passenger car without physically going through the portal, and falsely log an object or a personnel into the system database.

Although the prior art cited above is useful, none of the inventions include a secure portal scanner for tracking objects and personnel, a portal scanner that can ascertain in a particular location the presence of a particular objects or particular personnel being carried by several modes of transportation such as vehicles, tractor-trailers, or within a defined geographic area such as warehouses and buildings. It is accordingly the primary objective of the present invention to provide a secure electronic vehicle, cargo, and personnel tracking information system, which uses a portal scanner for tracking the present location of in a plurality of modes of transportation or at a plurality of physical locations.

It is a related objective of the present invention to enable the monitoring of objects or personnel by use of a secure portal scanner that incorporates a portal panel utilizing a plurality of photo optical sensors as first detectors mounted vertically into said portal panel. A second plurality of photo optical sensors are installed vertically, approx. 2 feet apart from first sensors in said portal panel as a secondary detector, both first and second detectors detection signal is used by said portal reader comparator CPU for indicating directional movement of a mass. At least one or two temperature sensing infrared sensors are also installed in said portal panel, for detecting human presence at said portal point of access, and said portal comparator CPU is used to indicate whether the passing object is that of human or not. An RFID antenna is installed within said portal panel for interrogating the RFID tag affixed to or carried by objects or personnel, and said portal CPU for identifying said tag.

It is a further objective of the present invention to provide a portal scanner which is capable of reading and identifying said object and personnel carrying tags, as well as indicate the directional movement of said objects and personnel tags, based on first sensor detection and a second sensor detection with or without human temperature presence detection sensing, and for registering an object or human movement towards a direction, along with RFID authentication detection. The present art provides hi-speed object or personnel moving directional detection and authentication, which is achieved mainly by use of fast detection response (10ms) optical sensors for directional movement detection and by use of RFID tag single antenna reader, with reading speed of 50ms. Total directional movement and authentication of object or personnel tag is accomplished

within 50 to 60ms. which prevents individuals from being able to remove the objects (i.e., throwing a package out off an cargo trailer) or personnel jump an entry /exit way of a passenger car. The method used in the present art requires the tagged object or personnel to be logged by the portal scanner as it passes by the portal scanner. As per the present art, in order to log an object or a person successfully, the tagged objects or personnel passing through said portal scanner is read by optical detection sensors and the RFID read antenna, so as to register a valid tagged object or personnel direction movement in a database registry.

In the preferred embodiment of the invention said portal scanner panel is tamper proof by use of built-in PIR, microwave or ultrasonic motion detector(s) which covers with an invisible shield the interior of said portal panel to detect any unauthorized opening or tampering of said portal panel, and portal unit location movement sensor are used to avoid any unauthorized moving or tempering of the portal panel. Additionally, the present invention portal scanner unit contains built in RF transmitter or transceiver to transmit all tag read data to a computer interface and or report such tamper event to said computer interface. The portal transceiver used in the present invention communicating with a supervisory data communication with said computer to ascertain the proper operation of said portal reader. The portal scanner communication with the computer interface could be a hard wire connection. The transceiver unit of present portal reader could be a wireless modem having connected to a GPS receiver unit mounted within said portal reader, to report the read tag data along with said portal unit location information to a monitoring station or a web server. The computer interface or a web server in its database contains alphanumeric or photographic information relating to each one of said plurality of tagged object or personnel. When the portal scanner reads a particular tag, an alphanumeric and or photographic information relating to said scanned tag will be downloaded on said site computer monitor, the operator or security personnel will be able to compare and identify the actual scanned object or personnel, with the matching object or personnel alphanumeric or photographic information appeared within said computer monitor or found in the internet server, for verifying the authenticity of said object and person, and for registering said event in its database.

To secure the operation of the present portal scanner, a built-in battery back up is implemented with a low battery detection and reporting circuitry. And since the present art requires only one RFID antenna driver circuitry in a point of access (for larger area coverage a slave antenna could be added on opposite side on same reader without sacrificing tag read speed), with plurality of vertically mount optical sensors approx. 2 feet apart on each side of antenna loop, and use of such portal scanner structure takes minimum physical space in a entry or exit way of a trailer, aircraft, railcar, building etc. Thus, use of one antenna reader makes the portal reader more economical and provides more cargo or personnel usable space, which makes the present art more practical for use. And finally the portal scanner could be used in conjunction with or incorporate a metal or explosive detection devise, which makes the system capable of detecting and identifying objects such as a luggage, packages or a pallets, or personnel carrying or containing metal objects or explosives.

SUMMARY OF THE INVENTION

The invention is designed to provide Vehicle, Product and personal tracking and control system that can record, store, maintain and retrieve a record of a plurality of locations and a plurality of objects or personal having transponders attached thereto and are either carried by various modes of transportation (e.g., vehicle, aircraft, ships, trains) as well as within a defined geographic area or physical location (e.g., warehouse, office building) where the defined zones have a plurality of points of access. It is a further object of the invention to provide an object or personal tracking and control system which makes use of portal RF antenna with infrared sensors which identifies and detects a direction in which objects or personals are moved through portals.

According to the invention, the system provides and maintains automatically the records of locations of plurality of objects and personal in real time, with the system including plurality of object and personal transponder tags mounted on object or personal for movement with a respective object or personal, each transponder tag utilized for transmitting a unique identification signal, a plurality of portal RF antenna with infrared sensors each is installed at a point of access on a vehicle or at or in a building. With each portal RF antenna with infrared sensor devices, said RF antenna is utilized for receiving the identification signal transmitted from the object or personal transponder tag as the object and/or person moves through the point of access and the infrared sensors which are used to detect the direction in which the object or personal is moving. Each infrared sensor device also generating a detection signal indicative of the detected direction of movement objects or personal and the identification signal of the object or personal in response to the RF antenna reading device which receives the identification signal and a Reader comparator CPU to processing and maintaining said data information.

Another aspect of the invention uses an infrared sensor for detecting an object or personal movement, an RF antenna to read said object or personal transponder tag unit and a second infrared sensor for detecting an object or personal movement. Said RF antenna with infrared sensors installed at a plurality of points of access. Said points of access at which said first and second infrared sensors are installed each having associated therewith a first direction of movement defined as a movement into said zone and a second direction of movement define as a movement out of said zone. In the preferred embodiment of the present invention heat detection infrared sensors are used in said portal scanner device to determine the direction of an object as well as whether said object is human or another object carrying an RFID tag. The portal scanner's CPU is also able to process and distinguish said detection signals and determine whether the object was a human or another object. The portal scanner can also detect the presence or absence of an object passing the scanner as well as whether said object is a human or another object.

Additionally, in the present invention, rather than using an RF transponder, a bar-code reader could be utilized to identify objects or personal carrying a bar-code label. Further, instead of an IR directional Mass movement detectors, Ultrasonic movement detectors could be utilized.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 Illustrates a Portal scanner panel with RFID read antenna and read CPU for readings RFID tags. 1st and 2nd row of retro-reflective photo optic sensors, for detection of mass movement. A reader Comparator for comparing said detected mass movement, and read tags, and a GPS modem.

FIG. 2 Illustrates same portal scanner panel with diffused reflection IR sensors for detection of mass direction movements.

FIG. 3 Illustrates a Portal scanner with dual panel using a master and slave RFID antenna for reading RFID tags and Through beam IR sensors for detection of mass direction movement.

FIG. 4 Illustrates Portal Scanner Block Diagram

DETAILED DESCRIPTION OF THE INVENTION

Electronic Vehicle, Cargo, personnel tracking system is illustrated in FIG 1 where a Portal scanner is used to identify and detect directional movement of a mass such as an, container, an object or a person carrying a tag 50, and transmit said information to a computer interface. The Portal scanner of the present invention utilizes an improved object and human identification and movement direction detection system. The portal scanner system of the present invention comprises of a portal panel 20 preferably with frontal panel material made of plastic or wood, and side and back panel material made of ferrous metal and aluminum for shielding the RF energy generated by the portal scanner antenna 22, to prevent radiated antenna energy to travel towards the back and the sides of said portal reader. The portal panel 20 contains a ray of first retro-reflective IR sensors 21, 24, 28 and reflectors 11, installed in said portal vertically for detecting mass movement. The portal panel 20 is equipped with a second row of vertically mount detectors 25, 27, 29 and reflectors 12, approx. 2 feet apart from said first row of detectors, for detecting mass movement. A Read antenna 22 is implemented in the portal scanner mounted on frontal panel 20, which is connected to a transponder read CPU 24 installed within said portal panel, to interrogate and read passing RFID tags 50, carried by an object or person. The RFID Read CPU 24, and the first row IR sensors 21, 24, 28 and the second row of IR sensors 25, 27, 29 is connected to a reader comparator CPU 26, which is designed to determine the direction flow of an object or personnel, bases on which row of sensors detected a mass movement first and which row of sensors detected said mass movement afterwards, and send the collected data from said transponder read CPU 24 along with direction movement data of said first and second row of sensors detection, and send both information data to a computer interface through a hardwire connection 15, or to a GPS/modem/RF transceiver 18, which transmits said collected data to a computer interface unit, or to a web server.

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In a preferred embodiment of the invention said portal scanner additionally could be equipped with plurality of sensors, in which at list 2 of said sensor could be human body heat detection sensors 22, 29 and the comparator CPU 26 will be able to differentiate said human body detection signals detected by said sensors 22, 29, and mass movement detection sensor signals 21,23, 25, 27, and transmit said human presence detection signal along with mass direction movement and identification information to a computer interface through a hard wire or wireless modem.

In a preferred embodiment, the comparator CPU 26 is equipped with a built-in digital counter, which will display the exact amount of objects and or personnel entry exit count. And displays entry/exit count information of passing object or personnel with or without carrying tag 50 on a separate count listing. The comparator CPU 26 in additional is equipped with a Buzzer, when an object or personnel passes through said portal without carrying a tag 50, the comparator CPU26 will Beep one time, indicating to the operator an object or personnel pass through without carrying an RFID tag, if the passing object carrying a RFID tag 50, the comparator CPU 26 buzzer will beep two times indicating to the operator the passing object or personnel is equipped with RFID tag. The portal scanner comparator CPU 26 operation additionally could be user programmable, to give audiovisual event report such as:

- Only RFID tag reading detected by said portal comparator CPU. = Audiovisual alarm.
- Constant RFID tag reading for a preset period of time = Audiovisual alarm
- Detection of an object and or personnel movement without RFID = Audiovisual alarm
- Constant detection of non moving mass for a preset period of time = Audiovisual alarm
- Only human movement direction detection by said comparator CPU = Audiovisual alarm

The present invention's portal scanner panel 20 is deigned to be of tamper proof design, the portal panel 20 contains an inner motion detector 20 an example; such as a PIR, Ultrasonic or microwave motion detector. To prevent unauthorized personnel opening and tempering of portal scanner, in addition to motion sensor 10 optical or pressure sensing tamper switches 37 are installed on the portal back and bottom panel side, facing towards the back or bottom of said portal panel 20, pressured or pointing against a back wall, or the floor which said portal is standing on or installed against, and used for the detection of unauthorized removal of a portal Scanner.

When an object or person carrying a RFID tag 50 passes through said portal scanner, pending on object or personnel direction movement, the portal scanner's first or second row of IR sensors detects a movement, the comparator CPU 26 registers a direction movement, based on which one of row (1st or 2nd) sensor detected said movement. If Temperature change is detected during said detection, then the comparator CPU 26 identifies said detection being of a human. If temperature change is not detected during said movement detection, then the comparator CPU 26 registers directional movement of object passed through said portal 20. At the same time the reader 24 through the antenna 22 will send an interrogation RF electromagnetic coded signal to said passing tag 50 which upon receipt of said interrogating signal, will transmit a signal containing information to said particular tag 50, the reader 24 upon receiving said

interrogation signal from said tag 50, will read said tag RFID information and pass said information to said comparator CPU 26. The Comparator CPU 26 transmits both said RFID and mass or human directional movement detection information, to an RF transmitter which transmits said information to a computer interface through a wireless modem unit equipped with a GPS receiver unit 18, which upon receipt of said signal transmits said object or personnel presence identification along with said object or personnel directional movement information, along with said portal scanner, and object or personnel location information. The portal scanner location information is important and useful, mainly when said portal scanner is installed in a mobile environment, such as a passenger car, a cargo trailer, rail car, aircraft Etc.

When particular object or personnel information is received by a computer interface, related cargo or personnel information will appear into the monitor of said computer. If said monitoring computer is installed near by said portal reader, the operator of said portal reader can visually verify actual object or person at his or her visual site, and compare it with alpha numeric and or photographic information found in the computer database. This will help security personnel to be able to identify the authenticity of a cargo or personnel. Exp. at an airport terminal, secure employment area, warehouse distribution center, retail merchandising Etc. The computer or server could be installed at a distant location; the portal scanner detection information will be transmitted and stored into said computer/server or into an Internet server. The information downloaded in the sever could be used for just in time management efficiencies, flow of distribution of products, monitoring of personnel attendance, driver/ passenger location and or authentication, etc.

In a preferred embodiment of the present invention, the portal scanner additionally is equipped with tamper detection sensors 10, 37, to detect unauthorized tampering with the inner section of said panel 20 or for unauthorized removal of said panel 20. upon tamper detection; said tamper detection information will send to a computer monitor, and the computer will alert the operator with an audiovisual warning. The computer interface additionally communicates with said portal scanner unit with a supervisory encryption coded signal, to secure proper operation of said portal scanner and to ascertain the proper communication leak between said computer and said portal scanner. The portal scanner of the present invention operates with AC power adaptor or vehicle power supply, as an additional alternative power supply the portal scanner of the present invention has a built-in rechargeable battery. If external power supply is being cut, the portal scanner comparator CPU will transmit a unique coded signal, to indicate portal unit is operating on back up battery power.

FIG. 2 illustrates a similar method for the use of the art, without use of reflectors. Which is achieved by use diffused-reflection sensors 21, 24, 28, 25, 27, 29.

FIG. 3 shows 2 portal panels facing each other, a master 40 and a slave 30. The master 40 contains a read antenna 42, connected to an RFID read CPU 46, using through beam optical mass movement detection method, which is immune from simulated reflector sensor tampering. Said first row of sensors optical collectors 45, 47, 49 are mounted

vertically on frontal panel of said portal, and a second row of sensors optical collectors 41, 43, 48 are mounted approx. 2 feet apart from said first vertically mount sensors collectors. Which is connected to a comparator CPU 44. The slave panel contains a slave antenna 32 connected to said reader CPU 46, and row of vertically mount optical sensor emitters 31,33, 35, as first emitters. And a second row emitters 34,38,36 mounted vertically on the panel approx. 2 feet apart from said first row of emitters. Use of 2 antennas facing each other shared by same reader circuitry provides better RFID tag reading in a larger entry/exit area, since through beam sensor does not use reflectors. Thus use of through beam sensors eliminates the possibility of one using a reflector to avoid the detector detecting mass directional movements.

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